Development of an inundation mapping capability using high resolution finite element modelling

by

C. Smith, P.D. Bates and M.G. Anderson

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Professor M G Anderson

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University of Bristol Missouri River modelling study

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Chris Smith, Paul Bates and Malcolm Anderson

Department of Geography, University of Bristol, Bristol, BS8 1SS, UK.

Abstract

This document looks at the work carried out in the first three months of this research contract, the position at the present time and the immediate continuation of this. This is divided between the two most important factors in running dynamic simulations, model development and data availability.

1. Project tasks at the University of Bristol Oct 1994 - Dec 1994

1. Initial model development
2. Data assembly and pre-processing

2. Model Development

The computer code being used in this project is TELEMAC-2D, a two dimensional (depth averaged) finite element solver for the Saint-Venant equations of fluid flow. The code has been developed by Electricité de France in Paris and has been successfully enhanced in a joint 2 year project between the University of Bristol and Electricité de France to model

fluvial flood flows. Applying this computer code to the Missouri River should present few problems once the necessary data has been assembled (see below).

Two models have been created so far, one covering the reach from Gavins Point Dam to the Maskell gauge site (see Figure 1) and the second, covering a much smaller region within the above reach, around the James River Island and confluence area (see Figure 2). The latter model has been made of this small region as most dynamic interest lies around this confluence. The resolution of the James River confluence model is much greater than for the full reach model so this can be used as a check on the performance of the full model in this most demanding area and indeed may lead to modifications of the full reach model if significant discrepancies are found. At present the possibility exists that a third model shall be created covering the reach from Gavins Point Dam to Gayville gauge site. This is because most of the flow variations occur within this part of the reach and it would make a significant saving on computational time when running some of the dynamic simulations.

So far the two models have been run successfully with estimated topography. This has shown that the models function well, giving physically realistic output and now only need actual topographic data to be applied before real simulations can be started.

3. Data Assembly and pre-processing

The data needed to apply the above models to the Missouri River consists mainly of flow data for the reach and detailed topographic data of the river. Currently we have flow data from four sites on the Missouri reach and one on the principle tributary, the James River. The data is hourly and covers the period from 1st May 1993 to 30th September 1993. This is more than adequate for our needs but two problems do exist:

i) We do not have fixed references to Ordnance Datum for stage elevations at the gauge sites. This data will be acquired prior to full model simulations during the next 3 month phase of this project.

ii) The flow data for the James river is taken from 33 miles above the confluence, well out of the model range, and therefore must be time lagged and possibly

attenuated before being used as a model input. This should easily be achieved by applying some simple well proven flood routing technique.

The initial topographic data for the channel has recently been received, consisting of twenty six cross sections of the full model reach. This data has been applied to the model's topographic interpolator in order to create a continuous topography for the reach. This interpolated topography shows some irregularities which we shall try to remove by either adding additional estimated cross sections or by modifying the interpolation program. More real data would however be better. Thus it can be seen that additional topographic data from other cross sections or LIDAR will be essential in improving the definition of the bed topography in the model and hence the accuracy of the model simulations.
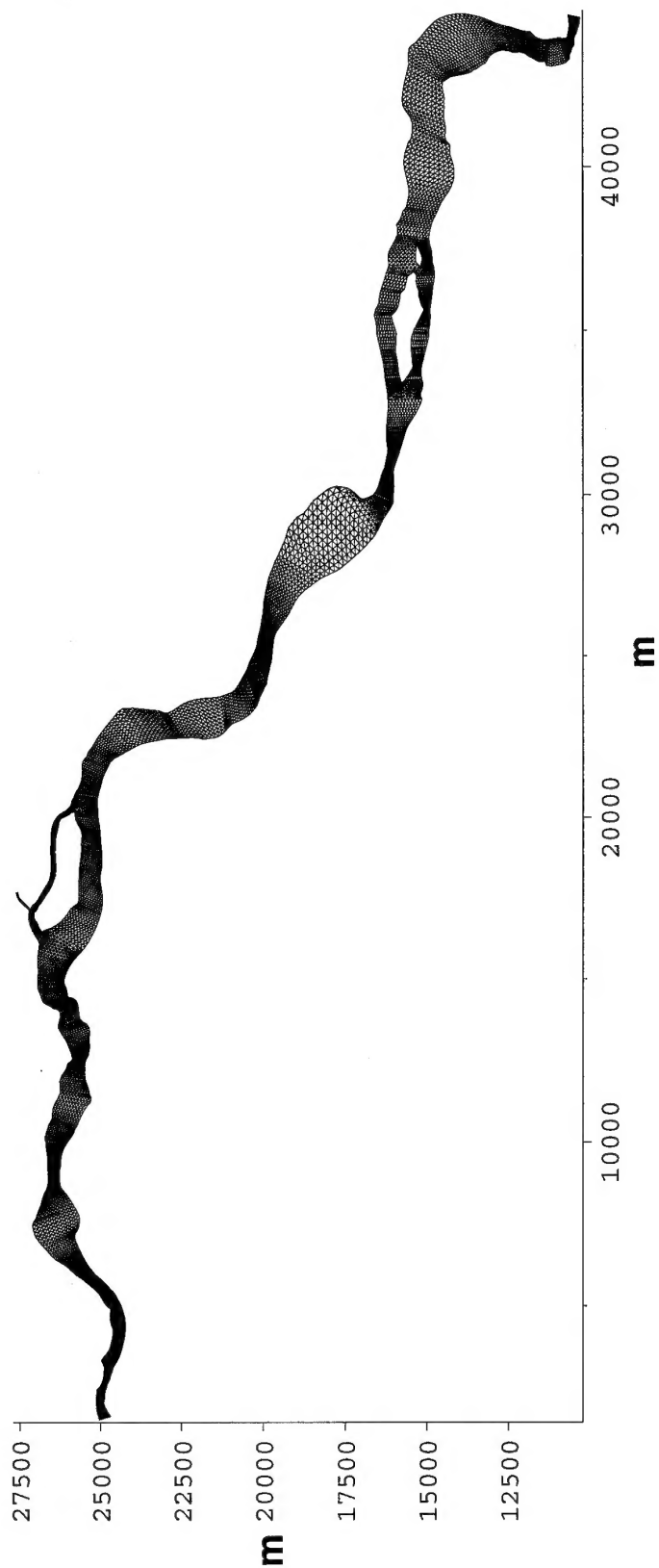
4. The Next Steps

As mentioned above the immediate concern is to create a realistic river bed topography from the available cross section data. This is not expected to be a major problem but could be time consuming given the large number of data points involved. Once this is sorted out the hydraulic model can then be advanced to a steady state over this realistic topography. This steady state hydraulic model is the starting point for dynamic simulations. Reaching this steady state shall probably take two weeks or more of model runs as the long reach length results in large travel times (a minimum of 24 hours) for flow information at the upstream external boundary to propagate through the reach. Once this steady state is achieved initial dynamic simulations will be carried out.

5. Summary of project achievements to date

1. Data assimilation and pre-processing for:
    (i) Flow data
    (ii) Surveyed cross sections
2. Construction of 2 finite element models
3. Model error checking and development of initial simulation with cross-section based topography.

Figure 1

Missouri main stem model

Figure 2

James River confluence model